COMPARATIVE PERFORMANCE OF WASTEWATER TREATMENT PLANTS IN THREE RUBBER GLOVE MANUFACTURING PLANTS

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ABSTRACT

During the manufacturing of rubber gloves, water is used as wash water at different stages to clean the rubber gloves, thus generating quite a substantial amount of effluent. There are four main sources of effluent, i.e. a) from the glove formers cleaning tank, which collects the acidified water used to clean these formers, b) latex dipping tank, where it collects wash water used to cool the tank during dipping process and the sludge form the tank itself, c) leaching tank, where it collects wash water used to leach out the pollutants from the gloves and lastly d) latex compounding, containing the washing water from ball mill, latex containers, uncoagulated latex and sludge. Often, these effluents contain high concentration of pollutants particularly the organic matters, which well exceeded the limit of the discharge standard under the Third Schedule of the Environmental Quality Regulations (Sewage and Industrial Effluents) 1979. Thus, it is extremely critical to treat these effluents to reduce the level of pollutants to within the permissible standards before being discharged into the rivers or receiving waters.

A comparative study on the performance of effluent treatment plants (WWTPs) from three rubber glove manufacturing factories was carried out. These factories, Factory A, B and C, have adopted similar design system for their WWTPs. The design system basically involved chemical-flocculation with dissolved air flotation (DAF) as the primary treatment, followed by activated sludge process (extended aeration) as the secondary treatment. While the design systems were alike, the sizes of these WWTPs were different. The WWTP for Factory A had a capacity to handle effluent volume of 166 m^3/d, while Factory B was designed to handle 1000 m^3/d of effluent.

Factory C was designed to cater approximately 1200 m^3/d of effluent generated from its production lines.

Three main parameters were selected for this study, namely Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Suspended Solids (SS). These three parameters measured the presence of organic matters and solid matters which contributed to the pollution of the effluent. The performance of the WWTP for the selected factories was ascertained based on its capability in reducing the levels of these three parameters from two aspects, i.e. the overall reduction and reduction at different stages of effluent treatments.

The study revealed that the characteristics of raw rubber glove manufacturing effluent from Factory A, B and C were quite similar and consistent. BOD concentration in rubber glove effluent for these factories ranged from 85 mg/l to 1035 mg/l, while SS concentration ranged from 32 mg/l to 1305 mg/l. The COD concentration obtained was within 300 mg/l and 4360 mg/l.

Overall the performances for the WWTPs for the three selected factories were found to be acceptable. The BOD, COD and SS concentrations were successfully reduced to the permissible limit of the DOE regulatory standards and could be discharged into the rivers and public drain safely. It was also found that the chemical-flocculation with DAF reduced substantial concentrations for the BOD, COD and SS. Hence, the effluent treatment was mainly by the physico-chemical treatment. However, the biological treatment was important to help to further reduce the pollutants to the allowable discharge limits. Thus, this design system involving the combination of chemical-flocculation with DAF, followed by an extended aeration treatment has proven to be effective and suitable in treating the effluent from rubber glove manufacturing industries.

The WWTP for Factory A displayed the highest efficiency in the overall percentage reduction of BOD, COD and SS as compared to Factory B and C. Similarly, for the primary treatment and secondary treatment respectively, Factory A had recorded highest percentage reduction for the three parameters. From the findings, the actual loading for the three parameters as compared to the design loading for these factories, was not 100% accurate, and thus could not be concluded that the performance of a WWTP decreased with the increased size of the plant. It was also not possible to establish a trend in the removal of BOD, COD and SS among these factories, due to lack of information on the actual manufacturing processes involved in these factories.

In loving memory of my beloved Dad.....

"I should have never procrastinated".

Lee Kuan / November 2001.

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LIST OF ABBREVIATIONS

BOD	Biochemical Oxygen Demand
CAF	Cavitation Air Flotation
CDC	Center for Disease Control and Prevention
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
d	day
DAF	Dissolved Air Flotation
DO	Dissolved Oxygen
DOE	Department of Environment
DS	Dissolved Solids
F/M	Food to Microorganism Ration
g	gramme
H_2O	Water
H_2S	Hydrogen Sulphide
HRT	Hydraulic Retention Time
IRG / GRG	Industrial and General Rubber Goods
kg	kilogramme
kPa	kilopascal
l	liter
LTC	Latex Timber Clone
m^3	cubic meter
m^3/d	cubic meter per day
MARGMA	Malaysian Rubber Gloves Manufacturers' Association
mg	milligramme

mm	millimeter
N_2 or N	Nitrogen (gas)
nm	nanometer
NR	natural rubber
O & G	Oil and Grease
O_2	Oxygen
P	Phosphorus
PAC	powdered activated carbon
ppm	Parts Per Million
RAS	Return Activated Sludge
RRIM	Rubber Research Institute of Malaysian
RSS	Ribbed Smoke Rubber
SET	Settleable Solids
SMR	Standard Malaysian Rubber
SR	Synthetic Rubber
SRT	Sludge Retention Time
SS	Suspended Solids
TPF	Tilted Plate Flotator
TS	Total Solids
UD	Undetected
USAB	Upflow Anaerobic Sludge Blanket
WAS	Waste Activated Sludge
WWT	Wastewater Treatment
WWTPs	Wastewater Treatment Plants
Zn	Zinc